
**Apprenticeship
In-school Curriculum Standards**

**Plumber
Level 3**

306A



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Table of Contents

Introduction	1
Stakeholders Information	2
Program Summary of Reportable Subjects	3
S00032 Plumbing Systems - Level 3	4
Waste Pipe Systems	
32.1 Acid Neutralizers.....	7
32.2 Indirect and Special Wastes	9
32.3 Commercial Kitchen Equipment and Water Using Devices	11
Water Distribution Systems	
32.4 Water Mains	15
32.5 Water Services	17
32.6 Municipal Water Supplies	19
32.7 Pressures and Heads	22
32.8 Private Water Supplies	23
32.9 Types of Pumps.....	24
32.10 Pressure Tanks.....	26
32.11 Boyle's Law.....	28
32.12 Hydro-Pneumatic Systems	29
32.13 Water Conditioning Equipment	31
32.14 Water Pipe Sizing	34
32.15 Linear Expansion.....	36
32.16 Commercial Hot Water Tanks.....	38
32.17 Indirect Heaters	40
32.18 Domestic Hot Water Circulation Lines and Pumps	42
32.19 Pressure Reducing Valves	45
32.20 Water Supplies to High Rise Buildings	45
32.21 Cross Connections and Backflow Prevention	48
32.22 Water Hammer	51
32.23 Standpipe Systems.....	53
32.24 Sprinkler Systems	56
Codes	
32.25 Fire Stopping	61
32.26 National Plumbing Code	63
Storm Drainage Systems	
32.27 Back Flooding	67
32.28 Open Flow and Metered Flow Roof Drain Systems	69

Sewage Disposal Systems

32.29	Private Sewage Disposal Systems	75
32.30	Municipal Sewage Disposal Systems	77

Piping Systems

32.31	Hydronic Heating Systems	81
32.32	Hydronic System Calculations	83
32.33	Natural Gas Piping Systems	85
32.34	Medical Gas Piping Systems	87
32.35	Industrial Process Piping Systems.....	89

S00033.0	Process Piping Systems	91
33.1	Perform Various Service, Maintenance, Repair, and Fabrication Assignments	92

S00034.0	Trade Documentation - Level 3.....	94
34.1	Identify, Read, and Interpret Plumbing and Hydronic Piping Drawings.....	95
34.2	Read and Interpret Job Specifications for ICI Sector	97
34.3	Produce Various Plumbing Drawings	99
34.4	Produce Hydronic Drawings	101
34.5	Bids and Contracts	103
34.6	Simple and Compound Interest	105

Summary of Equipment Recommended for Level 3	106
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Introduction

This new curriculum standard for the Plumber trade is designed from the learning outcomes, which were developed from the industry-approved training standard.

The curriculum is organized into **3 levels** of training, each including reportable subjects containing learning outcomes to reflect the units of the training standard. The hours charts indicate how the curriculum can be delivered in the current block release format and summarizes the hours of training for each reportable by level. Since the reportable subjects are all divisible by three they can be adapted to accommodate a more flexible training delivery other than block release.

The reportable subjects are cross-referenced to the training standard for ease of comparison.

Each reportable subject and learning outcome identifies a recommended number of training hours. This hour allotment is broken into hours for instruction in theory and practical application. The division of the curriculum into reportable subjects follows a natural progression of learning through the training program. This structure will allow training centres and apprentices' flexibility in program delivery while still observing the importance of sequencing learning in a logical progression.

The curriculum is framed by and includes specific references to terminal performance objectives in the Apprenticeship Training Standards for Plumber. However, the curriculum identifies only the learning that takes place off the job, in a training environment. The in-school program focuses primarily on the theoretical knowledge required to master the performance objectives of the Training Standards. Employers are expected to extend the apprentice's knowledge and skills through appropriate practical training on the work site. Regular evaluations of the apprentice's knowledge and skills are conducted throughout training to assure that all apprentices have achieved the learning outcomes identified in the curriculum standard. The balance between theoretical and practical evaluation is identified for each unit of learning outcomes.

Implementation:

January 2007

Stakeholders Information

A consortium of five colleges of applied arts and technology, working in collaboration with the MTCU (Ministry of Training, Colleges and Universities) and industry stakeholders, participated in the development of this document. A Project Steering Committee (PSC) was struck to guide the project development process for the Plumber documents.

The PSC worked with industry representatives during the development of the curriculum to ensure content validity. During various stages of the process, the PSC and participating industry advisory groups evaluated the draft curriculum documents and provided feedback and recommendations for revisions. The format that is used in this document has been approved by the MTCU.

Program Summary of Reportable Subjects

Number	Reportable Subjects	Hours Total	Hours Theory	Hours Practical
S00032	Plumbing Systems – Level 3	144	134	10
S00033	Process Piping Systems	48	-	48
S00034	Trade Documentation – Level 3	48	36	12
	Total	240	170	70

Plumber- Level 3

Number: S00032.0

Title: Plumbing Systems – Level 3

Duration: 144 Total Hours

Theory: 134 Practical: 10

Prerequisites: S00021, S00022, S00024, S00025, S00027, S00029, S00030,

Co-requisites: S00032, S00033, S00034

Evaluation Structure

Theory Testing	80%
Application Exercises	10%
Final Assessment	10%

WASTE PIPE SYSTEMS:

Plumber- Level 3

Number: S00032.1

Title: Acid Neutralizers

Duration: Total hours: 3

Theory: 3

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00027

Co-requisites: S00032

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to define, identify and describe the installation requirements for an acid neutralizer.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 1.1 Define the trade term, "acid neutralizers".
- 1.2 State the purpose of an acid neutralizer and the principle that enables acid to be neutralized.
- 1.3 List the conditions that are eliminated when an acid neutralizer is installed.
- 1.4 List locations and/or buildings that may require the installation of an acid neutralizer.
- 1.5 Explain when an acid neutralizer may and may not act as a fixture trap.
- 1.6 Identify the fixtures, appliances and devices that may discharge into an acid neutralizer.
- 1.7 State the installation requirements for acid neutralizers.
- 1.8 State the purpose of the vent piping that must be connected to an acid neutralizer.

Plumber- Level 3

- 1.9 Specify the vents required for an acid neutralizer.
- 1.10 Explain how to size the vent required for an acid neutralizer installation.
- 1.11 Identify the connection location for a vent serving an acid neutralizer.
- 1.12 Describe a water make-up connection to an acid neutralizer.
- 1.13 Identify by-laws controlling acid concentrations and removal.

Plumber- Level 3

Number: S00032.2

Title: Indirect and Special Waste Systems

Duration: Total hours: 6

Theory: 6

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00027

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to define, identify and describe the installation requirements for indirect and special waste installations.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 2.1 Define the term, "indirectly connected".
- 2.2 Explain the purpose of indirectly connecting a fixture.
- 2.3 Describe how an indirectly connected fixture is protected.
- 2.4 Identify the fixtures that must be indirectly connected.
- 2.5 Explain the purpose of a trap on an indirect waste pipe.
- 2.6 Specify the minimum pipe size of an indirect waste pipe serving one fixture.
- 2.7 Specify where cleanouts are required on an indirect waste pipe.
- 2.8 Identify the location where a receiving trap for an indirect waste pipe should be installed.
- 2.9 Define the term, "air break", state its purpose, and its minimum size.

Plumber- Level 3

- 2.10 Define the term, "air gap", state its purpose, and its minimum size.
- 2.11 State the size of a receiving trap for an indirect waste pipe serving one fixture.
- 2.12 Determine the size of a receiving trap for an indirect waste pipe serving more than one fixture.
- 2.13 Locate the termination of the vent extending from an indirectly connected stack in a multi-storey building.
- 2.14 Specify the minimum pipe size of an indirect waste pipe serving more than one fixture.
- 2.15 Describe the installation requirements for a floor drain installed in a walk-in cooler.
- 2.16 Identify the type of fixture drains that may be combined.
- 2.17 State the installation requirements for a group of combined fixture drains.
- 2.18 Size all the piping required for a receiving trap installation including the drainage piping, trap and vent pipe sizes.

Plumber- Level 3

Number: S00032.3

Title: **Commercial Kitchen Equipment and Water Using Devices**

Duration: Total hours: 1

Theory: 1

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00027

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5461, U5462, U5463, U5464

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain the installation of commercial and institutional equipment.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 3.1 Describe the purpose and the requirements of the following commercial and institutional equipment including:
- commercial dishwashers
 - commercial clothes washers
 - garbage grinders
 - vegetable peelers
 - coffee urns
 - refrigeration units
 - water dispensers and coolers
 - steam tables
 - hospital and lab service sinks
 - flushing rim sinks
 - laboratory tables
 - autopsy tables
 - bed-pan washers

Plumber- Level 3

- sterilizers
 - exhaust hoods
 - food scrap interceptors
- 3.2 Identify the fixtures, appliances and water using devices that should be indirectly connected.
- 3.3 Identify the fixtures, appliances and water using devices that should and should not discharge through a grease interceptor.

WATER DISTRIBUTION SYSTEM:

Plumber- Level 3

Number: S00032.4

Title: **Water Mains**

Duration: Total hours: 1

Theory: 1

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00027

Co-requisites: S00032, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain water main installations on private property.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 4.1 Define the following trade terms: "water main", "thrust block", and "restraints".
- 4.2 State the approved materials that may be installed for water mains.
- 4.3 State the approved sources of supply for a water distribution system.
- 4.4 State the type of projects that require the installation of a private water main.
- 4.5 Explain the installation procedures for each of the acceptable materials.
- 4.6 Explain the purpose of a thrust block.
- 4.7 State the material used in the construction of a thrust block.
- 4.8 Identify installation locations of thrust blocks.
- 4.9 Explain the sizing procedure for thrust blocks and restraints.

Plumber- Level 3

- 4.10 Explain the installation of cathodic protection for buried water mains.
- 4.11 State the minimum depth of burial of water mains in different localities throughout Ontario.

Plumber- Level 3

Number: S00032.5

Title: **Water Services**

Duration: Total hours: 1

Theory: 1

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00027

Co-requisites: S00032, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain water service pipe installations on private property.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 5.1 Define the term, "water service pipe".
- 5.2 State the installation locations of a water service pipe.
- 5.3 State the approved materials that may be installed for a water service pipe.
- 5.4 State the approved materials that may be installed in a water distribution system.
- 5.5 State the minimum size of a water service pipe.
- 5.6 Describe the spatial separation requirements for water service pipe.
- 5.7 State the thrust restraint requirements for water service pipes.
- 5.8 State the purpose of a tracer wire.
- 5.9 State when a tracer wire would and would not be required when installing a water service pipe or a fire service main.

Plumber- Level 3

- 5.10 State the type and gauge of wire to be used as a tracer wire.
- 5.11 State the type of water service pipe that must have a check valve installed at the building end of the water service.
- 5.12 Describe the purpose of the check valve installed at the building end of a water service pipe.

Plumber- Level 3

Number: S00032.6

Title: **Municipal Water Supplies**

Duration: Total hours: 6

Theory: 6

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00025, S00027, S00030

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462,
U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain municipal water treatment.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 6.1 State the estimated water consumption per capita for the average family in Ontario.
- 6.2 Describe how the degree and type of water treatments are determined.
- 6.3 Identify what all surface water contains.
- 6.4 Identify the term applied to the finely divided suspended and colloidal material that is too light to settle out of water.
- 6.5 State the cause of colour in the water.
- 6.6 Explain why bacteria must be removed from a potable water supply.
- 6.7 Explain the objective of water treatment.
- 6.8 Identify a number of pieces of equipment typically used in a water treatment plant.

- 6.9 Explain each of the following steps involved in a water treatment process, including:
- low lift pumping stations
 - flocculation
 - filtration
 - sedimentation
 - ultra-violet
 - reverse osmosis
 - distillation
 - chlorination
- 6.10 Review the latest technology used in municipal water treatment systems.
- 6.11 Complete a flow chart indicating the steps involved in water filtration for a typical water treatment plant.

Plumber- Level 3

Number: S00032.7

Title: **Pressure and Heads**

Duration: Total hours: 8

Theory: 8

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00024, S00029

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5458, U5459, U5461, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to define and calculate pressure and heads.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 7.1 Define the terms, "weight of water", "pressure of water", "PSI," "PSIG" and "PSIA".
- 7.2 State the unit of measurement used to express pressure in Imperial and SI.
- 7.3 Calculate the pressure in PSI and kPa from a given head in feet and meters.
- 7.4 Calculate the head in feet and inches from a given pressure.
- 7.5 Calculate the pressure, total force, and total weight for a number of given pipe, tank and combination tank and pipe problems.

Plumber- Level 3

Number: S00032.8

Title: Private Water Supplies

Duration: Total hours: 3

Theory: 3

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00027

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain common private water supplies.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 8.1 Identify the legislation governing the installation and servicing of water wells.
- 8.2 State the percentage of water in all living matter.
- 8.3 Explain the term, "hydrologic cycle", including:
 - precipitation
 - infiltration
 - percolation
 - evaporation
 - transpiration
 - condensation
- 8.4 List conditions that could cause the water table to lower.
- 8.5 State the major requirements of a private water supply.
- 8.6 Explain why any surface water supply should be carefully checked prior to human use and consumption.

- 8.7 Identify different cistern types.
- 8.8 Explain the installation of cisterns.
- 8.9 Explain the connections of the cistern to the water system.
- 8.10 Name the four different types of wells.
- 8.11 Describe the types of "shallow wells" and state their average maximum depth.
- 8.12 Identify the types of wells installed when penetrating through hard consolidations and rock.
- 8.13 State the depth of installation for a drilled or tubular well.
- 8.14 Explain how and why a bored well must be curbed or lined.
- 8.15 Describe the conditions that often effect dug well water quality.
- 8.16 Identify the type of ground suitable for driven wells and where they are most practical.
- 8.17 Identify the type of well that uses the well casing as a delivery tube.
- 8.18 State where drilled wells should be installed.
- 8.19 Explain the advantages of a drilled well and the purpose of a well casing.
- 8.20 Identify the type of pipe used to case a drilled well.
- 8.21 State the sizes of casings used for drilled wells.
- 8.22 State the termination point of a well casing and how it is sealed.
- 8.23 Explain the different ways a well casing may be terminated, or capped off below or above finished grade.
- 8.24 Explain the advantages and disadvantages of each well type.
- 8.24 Explain the terms, "static water level" and "drawdown".

Plumber- Level 3

Number: S00032.9

Title: **Types of Pumps**

Duration: Total hours: 3

Theory: 2

Individual/Group Work: 0

Out of Class Practical: 1

Prerequisites: S00022, S00027

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462,
U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain the basic operating principles of common pumps installed in plumbing systems.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 9.1 Define the following terms: "pump," "suction lift", "discharge head", and "total dynamic head".
- 9.2 Explain how the capacity of a pump is expressed.
- 9.3 Identify the two basic types of pumps.
- 9.4 Identify the common types of pumps installed including:
 - centrifugal pumps
 - jet pumps
 - submersible pumps
 - piston pumps
- 9.5 Explain the operating principle of a positive displacement pump and centrifugal pump.

- 9.6 State the advantages and disadvantages of centrifugal pumps and positive displacement type pumps.
- 9.7 Explain the operating principle of a jet-venturi.
- 9.8 Explain the maximum theoretical lift of a shallow well jet pump.
- 9.9 Explain how the lifting capacity is increased in a deep well pump.
- 9.10 Define the following terms: "drive pipe", "suction line", and "foot valve".
- 9.11 Explain the relationship of the water traveling through the drive pipe and suction line in a deep well jet pump installation.
- 9.12 Explain the function of a foot valve and identify its installation location.
- 9.13 Define the term, "submersible pump".
- 9.14 Explain the operating principles of a submersible pump.
- 9.15 State the installation requirements (including electrical and grounding requirements) of a submersible pump including the installation of a:
 - pit-less adaptor
 - torque arrester
 - rope
 - pump control panel
- 9.15 State the selection factors used to determine if a submersible or a jet pump is to be installed for a given installation.
- 9.16 State the standard pressure control settings for a domestic hydro-pneumatic system.

Plumber- Level 3

Number: S00032.10

Title: Pressure Tanks

Duration: Total hours: 4

Theory: 2

Individual/Group Work: 0

Out of Class Practical: 2

Prerequisites: S00021, S00024, S00027, S00029

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462,
U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, size and explain the purpose and installation requirements of a pressure tank.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 10.1 Define the terms, "pressure tank" and "waterlogged", in relation to pressure tanks.
- 10.2 Explain the purpose of pressure tanks and identify their installation location.
- 10.3 Explain the condition created by a waterlogged pressure tank.
- 10.4 Explain the function of an air volume control valve.
- 10.5 Identify where air volume control valves are installed on pressure tanks.
- 10.6 Explain how the installation of an air volume control valve helps prevent a pressure tank from becoming waterlogged.
- 10.7 Explain the difference between a standard pressure tank and a captive air pressure tank and why a captive air tank does not become waterlogged.

- 10.8 Identify how to calculate the pre-charge pressure of a captive air tank.
- 10.9 Identify the materials used to construct standard and captive air pressure tanks.
- 10.10 Explain the purpose of the pressure relief valve installed in conjunction with a submersible water pump.
- 10.11 State the sizing method recommended to determine the capacity of a pressure tank.
- 10.12 Determine the amount of water that will be delivered from both a standard and a captive air tank of a given size, at a given operating pressure range.
- 10.13 Calculate, given the pressure tank size and control settings for a given hydro-pneumatic system installation the volume of air in the tank at a given pressure, the discharge of water in gallons/litres and the ratio of water discharged to total volume during the cycle.

Plumber- Level 3

Number: S00032.11

Title: Boyle's Law

Duration: Total hours: 3

Theory: 3

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00024, S00029

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5458, U5459, U5461, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to solve trade-related problems using Boyle's law.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 11.1 Define Boyle's Law.
- 11.2 State the formula for Boyle's Law.
- 11.3 Apply Boyle's Law to a number of trade-related problems, including the calculation of the volume of:
 - pressure tanks.
 - pre-charged pressure tanks.
 - air chambers

Plumber- Level 3

Number: S00032.12

Title: **Hydro-Pneumatic Systems**

Duration: Total hours: 6

Theory: 4

Individual/Group Work: 0

Out of Class Practical: 2

Prerequisites: S00022, S00024, S00027, S00029

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462,
U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, explain and size basic hydro-pneumatic water systems.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 12.1 Explain the term, "hydro-pneumatic water systems".
- 12.2 State the major components of a hydro-pneumatic water system.
- 12.3 List the primary factors used to select a pump.
- 12.4 Explain how to determine daily water requirements.
- 12.5 Identify the use of a performance curve chart in the selection of a water pump.
- 12.6 Explain the following terms:
 - "static water level"
 - "drawdown"
 - "friction loss"
 - "suction lift"
 - "discharge head"
 - "total dynamic head"

- 12.7 Determine the jet or submersible water pump required for a given installation by calculating:
- friction loss
 - suction lift
 - discharge head
 - total dynamic head
- 12.8 Determine the available maximum and minimum water pressure at the highest faucet location considering:
- head loss
 - friction loss
 - GPM/velocity
 - Voltage

Plumber- Level 3

Number: S00032.13

Title: Water Conditioning Equipment

Duration: Total hours: 6

Theory: 4

Individual/Group Work: 0

Out of Class Practical: 2

Prerequisites: S00022, S00024, S00027, S00029

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain the operating principles of water conditioning equipment.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 13.1 Identify the common impurities and contaminants found in water.
- 13.2 Explain the difference between an impurity and a contaminate.
- 13.3 Explain how the amount of impurities is expressed.
- 13.4 Define the term, "hard water".
- 13.5 Explain the difficulties encountered when using hard water.
- 13.6 Identify the conditioning equipment used to condition hard water.
- 13.7 Describe two ways of measuring the degree of hardness in water.
- 13.8 Name the solution used to determine the amount of hardness in water.
- 13.9 Identify the types of hardness.

- 13.10 Explain how to convert parts per million (PPM) to grains per US gallon (GPG).
- 13.11 Explain how to convert parts per million (PPM) to grains per Imperial gallon (GPG).
- 13.12 Identify the material used in the exchange process of a water softener.
- 13.13 Identify the substance used to regenerate a water softener.
- 13.14 Identify the working components of a water softener.
- 13.15 Explain each operation cycle of a water softener.
- 13.16 Calculate the capacity of a water softener.
- 13.17 Identify to where the discharge pipe from a water softener should connect.
- 13.18 Identify the typical installation location for water softeners.
- 13.19 Describe the effects of iron in the water and high iron content in a water supply.
- 13.20 Identify the conditioning equipment installed to remove iron in a water supply.
- 13.21 Explain the operating principle of an iron filter.
- 13.22 Explain where an iron filter should be installed in relation to a water softener.
- 13.23 Explain the effects of high sulphur content in a water supply.
- 13.24 Identify the water conditioning equipment installed to remove excess sulphur in a water supply.
- 13.25 Explain the two types of filters installed for the removal of iron and sulphur.
- 13.26 Define the term, "reverse osmosis" (RO).
- 13.27 Describe the operating principle of an RO unit.
- 13.28 Explain the types of contaminants and impurities that may be removed with an RO unit.
- 13.29 Explain the term, "ultra-violet light (UV) unit".
- 13.30 Explain the operating principle of an UV unit.
- 13.31 Explain the types of contaminants that may be treated with an UV unit affects.

Plumber- Level 3

- 13.32 Explain the operating principle of a chlorinator.
- 13.33 Explain the types of contaminants that may be treated with a chlorinator installation.
- 13.34 Explain the operation principle of a distilled water system.
- 13.35 Review the latest technology used in water treatment processes.

Plumber- Level 3

Number: S00032.14

Title: **Water Pipe Sizing**

Duration: Total hours: 6

Theory: 6

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00024, S00027, S00029

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to size water distribution systems based on the Ontario Building Code.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 14.1 Determine optimum flow velocity in a water distribution system.
- 14.2 Define the terms, "friction loss" and "water supply fixture unit".
- 14.3 Identify how pipe size affects friction loss.
- 14.4 Calculate the velocity for different pipe sizes and volume of water required.
- 14.5 Identify the tables used to size the potable water distribution system.
- 14.6 Explain how to use the tables to size the potable water distribution system.
- 14.7 Explain how to determine the supply pressure to a building.
- 14.8 Determine the total water supply fixture units for a given installation.
- 14.9 Determine the length of the distribution main for a given installation.

- 14.10 Determine the incoming water supply pressure.
- 14.11 Determine the total height of the water supply system.
- 14.12 Using the above information and the appropriate tables, size the branch lines and distribution main for both the domestic hot and cold water piping systems.

Plumber- Level 3

Number: S00032.15

Title: Linear Expansion

Duration: Total hours: 3

Theory: 3

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00024, S00029

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5458 U5459 U5461 U5463 U5464 U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to define, calculate, control the effects and incorporate methods to control linear expansion.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 15.1 Define the following terms: "linear expansion", "superficial expansion", and "volumetric expansion".
- 15.2 State the term used to describe the expansion of a given material.
- 15.3 Describe how most piping materials will expand when heated or cooled.
- 15.4 State the coefficient of expansion for various piping materials including:
 - copper
 - steel
 - cast iron
 - ABS
 - PVC
- 15.5 Identify the rate of expansion for a material over a given temperature change.
- 15.6 Calculate the increase in length of a material over a given temperature change.

Plumber- Level 3

- 15.7 Explain the effects on a piping system when provisions for linear expansion have not been taken.
- 15.8 Identify and explain the provision that may be taken to prevent, reduce and/or control the effects of linear expansion on a piping system installation.

Plumber- Level 3

Number: S00032.16

Title: Commercial Hot Water Tanks

Duration: Total hours: 3

Theory: 3

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00025, S00027, S00030

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain commercial hot water tank installations.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 16.1 Define the term, "commercial hot water tank".
- 16.2 State the purpose of a commercial hot water tank installation.
- 16.3 Describe the different types of hot water storage systems.
- 16.4 Identify the six regulatory agencies for certification and installation methods of commercial hot water tanks.
- 16.5 Explain the 21 safety requirements for the different types of installation.
- 16.6 Explain why some storage tanks are elevated above their heating units.
- 16.7 Identify the preferred hot water and cold-water connection points to storage tanks and commercial hot water tanks.
- 16.8 Define the terms, "series" and "parallel", applied to the installation of hot water tanks.

- 16.9 Describe the operation of a "series" and "parallel" hot water tank installation and the difference in their installation and operation.
- 16.10 Define the terms, "tempering valve" and "booster tank", applied to commercial hot water tank installations and identify the type of installation that may use them in its hot water distribution system installation.
- 16.11 Explain the operation of a tempering/mixing valve and booster tank on a two-temperature hot water storage system.
- 16.12 Complete the drawing of single line elevation drawings of tank installations including: series and parallel commercial hot water, tempering valve and booster tank installations featuring all required check, shut off, control, temperature and pressure relief and drain valves.

Plumber- Level 3

Number: S00032.17

Title: Indirect Heaters

Duration: Total hours: 3

Theory: 3

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00025, S00027, S00030

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain indirect heaters installations and operations.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 17.1 Explain the term, "indirect", applied to domestic hot water systems.
- 17.2 Explain the characteristics of a separate domestic water-heating boiler.
- 17.3 Explain the term, "combination hot water heating system".
- 17.4 Explain the operation of a domestic combination hot water heating system.
- 17.5 Describe the installation and operation of a separate domestic water-heating boiler.
- 17.6 Describe the installation and operation of a combination hot water heating system.
- 17.8 Identify the controls required for the operation of convection and pump circulated domestic hot water heating boilers including:
 - aquastats
 - high limit controls
 - flow switches

- 17.9 Define the trade term, "heat exchanger".
- 17.10 Describe the installation and operation of a:
- heat exchanger
 - boiler immersion heat exchanger
 - tank immersion heat exchanger
 - separate immersion heat exchanger
- 17.11 Define the term, "converter".
- 17.12 Define the term, "convector".
- 17.13 Describe the installation and operation of a converter
- boiler immersion converter
 - separate converter
 - tank immersion converter
- 17.14 State some other common uses for heat exchangers and converters.
- 17.15 Draw a single line elevation drawing of a boiler immersion heat exchanger installation illustrating the boiler, storage tank, piping, valves, pump, pump by-pass, control wiring.
- 17.16 Draw a single line elevation drawing of a boiler immersion converter installation illustrating the boiler, storage tank, piping, valves, pump, pump by-pass, control basic wiring.
- 17.17 Draw a single line elevation drawing of a separate heat exchanger installation illustrating the boiler, storage tank, piping, valves, pump, pump by-pass, control wiring.
- 17.18 Draw a single line elevation drawing of a separate converter installation illustrating the boiler, storage tank, piping, valves, pump, pump by-pass, control wiring.
- 17.19 Draw a single line elevation drawing of a tank immersion heat exchanger installation illustrating the boiler, storage tank, piping, valves, pump, pump by-pass, control wiring.
- 17.20 Draw a single line elevation drawing of a tank immersion converter installation illustrating the boiler, storage tank, piping, valves, pump, pump by-pass, control wiring.

Plumber- Level 3

Number: S00032.18

Title: Domestic Hot Water Circulation Lines and Pumps

Duration: Total hours: 3

Theory: 3

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00024, S00025, S00027, S00029, S00030

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain domestic hot water circulation systems.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 18.1 Define the trade terms, "hot water circulation piping" and "hot water circulation pumps".
- 18.2 Describe the purpose of a domestic hot water circulation system.
- 18.3 Describe the type of installations that may have a hot water circulation system installed.
- 18.4 Explain the principle of operation of a domestic hot water circulation system.
- 18.5 Describe the characteristics of domestic hot water circulation pumps including:
 - materials used for the impeller and impeller body construction
 - pressure ratings
- 18.6 Explain the purpose of a by-pass installed with a domestic hot water circulation pump.

- 18.7 Calculate the size of a circulating line.
- 18.8 Calculate the size of the circulating pump.
- 18.9 Describe the installation requirements of a by-pass installed with a domestic hot water circulation pump.
- 18.10 Identify the types and purpose of valves installed in a domestic hot water circulation system.
- 18.11 State the installation location of valves in a domestic hot water circulation system.
- 18.12 Draw a single line elevation drawing of a domestic hot water circulation pump and the by-pass installation.
- 18.13 Draw a single line elevation drawing of a domestic hot water circulation system of the convection circulated, pump assisted and pump operated type.

Plumber- Level 3

Number: S00032.19

Title: **Pressure Reducing Valves**

Duration: Total hours: 1

Theory: 1

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00025, S00027, S00030

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain pressure reducing valves and pressure reducing valve installations.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 19.1 Define the term, "pressure-reducing valve".
- 19.2 Define the following terms used in PRV installations, including:
 - "no-flow pressure"
 - "reduced pressure fall off"
 - "reduced flow pressure"
 - "series P.R.V. installations"
 - "parallel P.R.V. installations"
- 19.3 Describe the operating principle of a PRV.
- 19.4 Explain how to adjust a PRV to increase and decrease the downstream pressure.
- 19.5 Define the term, "pilot operated PRV".
- 19.6 Explain the difference between a pilot-operated P.R.V. and a standard PRV.

- 19.7 List the common uses for a PRV in a water distribution system installation.
- 19.8 Explain why a strainer assembly should be installed upstream of a PRV, and why a pressure relief valve must be installed downstream, or on the house side of a PRV when the PRV is installed to supply water to a hot water heating device.
- 19.8 Describe and explain the purpose of a series and a parallel PRV installation, the latter with PRV set at different operating pressures.
- 19.9 Draw a single line elevation drawing illustrating a series and a parallel PRV installation including all required valves, strainers and piping required.

Plumber- Level 3

Number: S00032.20

Title: Water Supplies to High Rise Buildings

Duration: Total hours: 6

Theory: 6

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00025, S00027, S00030

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain water supply systems to high-rise buildings.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 20.1 Define the term, "pressure booster system".
- 20.2 Discuss the terms, "low-rise" and "high-rise".
- 20.3 Identify the factors that determine if a booster system installation is required.
- 20.4 Identify and explain the operation of the common high rise distribution systems operating with, or without pressure booster pumps including:
 - up-feed systems
 - down-feed systems
 - combination up feed down-feed systems
 - mains pressure up feed, booster pump down-feed system
 - PRV down-feed system
 - combination up-feed down-feed PRV system

Plumber- Level 3

- 20.5 Describe the characteristics of domestic pressure booster pumps including:
- materials used for the impeller and impeller body construction
 - pressure ratings
- 20.6 Explain the purpose of and describe the installation requirements of a by-pass installed with a domestic pressure booster pump.
- 20.7 Identify and explain the operation of the common domestic pressure booster pump installations including:
- continuous running
 - continuous running with a pressure relief valve
 - continuous running with intermittent running booster pump
 - dual alternating
 - dual alternating with hydro-pneumatic pressure tank
- 20.8 Draw a single line elevation drawing illustrating:
- up-feed booster systems
 - down-feed booster systems
 - combination up feed down-feed booster system
 - mains pressure up feed, booster pump down-feed system
 - P.R.V. down-feed system
 - combination up-feed down-feed system, PRV booster system
- 20.9 Draw a single line elevation drawing including the booster pump, pump controls, bypasses and control valves illustrating:
- continuous running booster pump
 - continuous running booster pump installation with a pressure relief valve
 - continuous running booster pump with intermittent running booster pump
 - dual alternating booster pumps
 - dual alternating booster pumps with a hydro-pneumatic pressure tank

Plumber- Level 3

Number: S00032.21

Title: **Cross Connections and Backflow Prevention**

Duration: Total hours: 8

Theory: 6

Individual/Group Work: 0

Out of Class Practical: 2

Prerequisites: S00021, S00022, S00024, S00027, S00029, S00030

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462,
U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain cross connections and apply necessary backflow prevention.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

21.1 Define the following terms:

- "backflow preventer"
- "cross connection"
- "backflow"
- "back siphonage backflow"
- "back-pressure backflow"
- "pollutant"
- "critical level"
- "contaminant"
- "minor hazard"
- "moderate hazard"
- "severe hazard"
- "individual isolation"
- "area or zone isolation"
- "premise isolation"

- 21.2 Identify the ten different ways to control backflow conditions, including:
- barometric loops
 - air gaps
 - hose connection vacuum breakers
 - laboratory faucet vacuum breakers
 - atmospheric vacuum breakers
 - pressure vacuum breakers
 - dual check with intermediate port (vending machine backflow preventer)
 - dual check with atmospheric port
 - double check valve assembly
 - reduced pressure assembly
- 21.3 Explain how to select a backflow prevention device.
- 21.4 Identify the type of building that requires premise isolation.
- 21.5 List 5 cross-connections that constitute a minor hazard.
- 21.6 List 5 cross-connections that constitute a moderate hazard.
- 21.7 List 5 cross-connections that constitute a severe hazard.
- 21.8 Identify the minimum height of an air gap.
- 21.9 Explain the concern in the installation of air gaps in areas with toxic or hazardous atmospheres.
- 21.10 Describe the installation requirements for atmospheric vacuum breakers including the height above the critical level the device must be installed.
- 21.11 Describe the installation requirements for pressure vacuum breakers including the height above the critical level the device must be installed.
- 21.12 Explain why shut off valves must be supplied with all testable backflow prevention devices.
- 21.13 Identify and list the backflow preventer that cannot be operated under continuous pressure.
- 21.14 Identify and list the backflow prevention devices that may be used to isolate minor hazards only.

Plumber- Level 3

- 21.15 Identify and list the backflow prevention devices that may be used to isolate minor and moderate hazards.
- 21.16 Identify and list the backflow prevention devices that may be used to isolate minor, moderate and severe hazards.
- 21.17 Identify and list the backflow prevention devices that may be used to protect against back-siphonage backflow conditions only.
- 21.18 Identify and list the backflow prevention devices that may be used to protect against both back-siphonage and backpressure backflow conditions.
- 21.19 Explain the installation recommendations for backflow prevention devices.
- 21.20 Identify when backflow prevention devices must be tested.
- 21.21 Identify who may test backflow prevention devices in Ontario.

Plumber- Level 3

Number: S00032.22

Title: **Water Hammer**

Duration: Total hours: 3

Theory: 3

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00027

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain and control the effects of a water hammer condition on a water distribution system.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 22.1 Define the term, "water hammer", and state its primary cause.
- 22.2 Explain what happens in a water distribution system when water hammer occurs.
- 22.3 Explain how much pressure may be created in the water distribution piping when water hammer occurs.
- 22.4 Describe the relationship between system pressure and flow velocities and the resulting water hammer pressures and calculate the pressure created given the initial flow velocity and system pressure.
- 22.5 Identify three types of valves that may cause a water hammer condition.

Plumber- Level 3

- 22.6 Explain why water hammer will eventually stop and describe its effects on a system.
- 22.7 Explain how an air chamber controls the effects of water hammer and its disadvantage.
- 22.8 Describe how to re-charge an air chamber.
- 22.9 Identify common types of water hammer arresters, explain their operating principles, how they are rated and explain how to select an arrester for a given installation.
- 22.10 Explain the selection and sizing of water hammer arresters to PDI standards.
- 22.11 Draw a number of single line elevation drawings sizing and installing water hammer arresters on the water distribution piping as required.

Plumber- Level 3

Number: S00032.23

Title: Standpipe Systems

Duration: Total hours: 3

Theory: 3

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00024, S00027, S00029

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain standpipe system installations.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 23.1 Define the term, "standpipe and hose system".
- 23.2 Explain the effectiveness of standpipe and hose systems when compared to other types of fire protection systems.
- 23.3 List the three classes of service for standpipe and hose systems.
- 23.4 Describe the design and operation of the four basic types of standpipe and hose systems.
- 23.5 Describe a "combined system".
- 23.6 Specify the minimum water supply for a combined system for a light-hazard high-rise building protected by sprinklers.
- 23.7 Explain when and why the smaller hose may be omitted in a Class II system.

Plumber- Level 3

- 23.8 List the factors governing the size of a standpipe for a given installation
- 23.9 Specify the minimum supply rates and pressures for Class I, II and III services.
- 23.10 Describe and list the requirements pertaining to a fire department connection.
- 23.11 State the requirements pertaining to the connection of gravity or pressure tanks on the top floor or roof of a building to a standpipe system.
- 23.12 State the requirements pertaining to the connection of gravity or pressure tanks to a common riser and to the installation of two or more standpipes in the same building or section of a building.
- 23.13 Specify the type of valves installed on the connections to each water supply and to be installed on risers that utilize a common water supply.
- 23.14 Describe the purpose, location and installation of indicator post valves.
- 23.15 Specify the types of pipe, fittings and pressure gauges that may be installed in a standpipe and hose system.
- 23.16 Identify the location of pressure gauges in a standpipe and hose system.
- 23.17 State the installation requirements of water flow alarms in a standpipe and hose system.
- 23.18 Specify the hydrostatic tests requirements for a standpipe and hose system.
- 23.19 State the recommended maximum interval between tests for a dry pipe standpipe and hose system.
- 23.20 Describe the suggested pressure test for systems that have been out of service for a number of years.
- 23.21 Describe the recommended procedure to be followed when a system is to be out of service.
- 23.22 State the requirements pertaining to standpipe installations in buildings under construction.

Plumber- Level 3

- 23.23 State the requirements pertaining to the vertical supports of standpipes in buildings under construction.
- 23.24 State the requirements pertaining to the installation of fire department connections in a building under construction.
- 23.25 Identify the location of hose valves in buildings under construction.
- 23.26 Specify the type of threads allowed on hose connections.
- 23.27 Identify the location of the uppermost hose connection during construction and the requirements pertaining to this condition.
- 23.28 State the length of time a temporary standpipe must remain in service.
- 23.29 Identify the location of signs indicating the fire department connection.
- 23.30 Explain the circumstances when a telephone system should be installed in conjunction with the standpipe system.
- 23.31 Explain the sizing of a standpipe system.

Plumber- Level 3

Number: S00032.24

Title: Sprinkler Systems

Duration: Total hours: 3

Theory: 3

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00027

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462,
U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain the installation of sprinkler systems.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 24.1 State the purpose of a sprinkler system.
- 24.2 Identify and describe the two main types of sprinkler systems.
- 24.3 Explain the operation of and why a "jockey / booster" pump is installed in a sprinkler system.
- 24.4 Identify where an anti-freeze system would be installed in a sprinkler system.
- 24.5 Describe the installation requirements when connecting an anti-freeze sprinkler system into an existing system.
- 24.6 Describe the difference between a pendant and upright sprinkler head.
- 24.7 Define the terms, "side-wall sprinkler head" and "deluge system".
- 24.8 Describe the function of a fusible link in a sprinkler head.
- 24.9 List the temperature and colour coding for sprinkler heads.

Plumber- Level 3

- 24.10 Describe the function of a frangible sprinkler head.
- 24.11 State the minimum allowable water pressure at the highest sprinkler head installed in the system.
- 24.12 State the common pipe size installed for standard sprinkler head.
- 24.13 State what must be done when a sprinkler head has discharged.
- 24.14 List three types of hazard areas.
- 24.15 State the number of square feet a sprinkler head will cover in each type of hazard area.
- 24.16 Define the term, "supervisory valve".
- 24.17 Describe the function of a flow indicator in a sprinkler system installation.
- 24.18 Describe the operation of a water gong.
- 24.19 List the number of sprinkler heads that can be installed in one area in an extra hazard occupancy on 1½", 3" and 6" pipe.
- 24.20 List the number of sprinkler heads that can be installed in one area in an ordinary hazard occupancy on 1½", 2" and 3" pipe.
- 24.21 Identify the smallest permissible flushing connection pipe size.
- 24.22 Name two types of alarms installed with sprinkler system installations.
- 24.23 Describe a pre-action sprinkler system.
- 24.24 State the normal hydrostatic pressure used to test a new sprinkler system.
- 24.25 Explain the meaning of "UL Approved" in conjunction with a sprinkler system installation.
- 24.26 Identify which NFPA standard is used for the installation of sprinkler systems.
- 24.27 Describe the operation of a foam fire protection system.
- 24.28 Describe the operation of a halon system.
- 24.29 Identify where a foam fire protection system should be installed.

24.30 State where a carbon dioxide fire protection system would be installed.

24.31 Explain the hazards of a carbon dioxide fire protection system.

CODES:

Plumber- Level 3

Number: S00032.25

Title: **Fire Stopping**

Duration: Total hours: 3

Theory: 3

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00021, S00022, S00027

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462,
U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and select fire stopping.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 25.1 Define the trade term, "fire stopping", and explain the purpose of fire stopping.
- 25.2 State the sections of the job specification and OBC that regulates the selection and installation of fire stopping.
- 25.3 Define the terms, "flame spread rating" and "smoke development rating".
- 25.4 Identify the materials installed in plumbing systems that may require the installation of fire stopping.
- 25.5 Identify and list the factors involved in the selection and installation of fire stopping.
- 25.6 Identify different type of fire stopping devices approved for installation.
- 25.7 Describe the installation requirements of common fire stopping devices.
- 25.8 Identify the installation location of fire stopping from a given construction drawing.

- 25.9 Identify the inspectors who are responsible for inspection of fire stopping.
- 25.10 Explain when a fire stopping installation would require inspection.
- 25.11 Identify the key examination points when fire stopping is being inspected.

Plumber- Level 3

Number: S00032.26

Title: **National Plumbing Code**

Duration: Total hours: 1
Theory: 1
Individual/Group Work: 0
Out of Class Practical: 0

Prerequisites: S00022, S00027

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain the use of the National Plumbing Code.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 26.1 Describe the purpose of the National Plumbing Code.
- 26.2 State the Provinces not under the jurisdiction of the National Plumbing Code.
- 26.3 Identify the examination based upon the National Plumbing Code.
- 26.4 Identify different locations where the National Plumbing Code may be available for study purposes.
- 26.5 State the differences between the Ontario Building Code (Part 3 and Part 7) and the National Plumbing Code.

STORM DRAINAGE SYSTEMS:

Plumber- Level 3

Number: S00032.27

Title: **Back Flooding**

Duration: Total hours: 1

Theory: 1

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00024, S00025, S00027, S00029, S00030

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5463, U5465, U5466

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain back flooding and describe the methods of controlling it.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

27.1 Define the meaning of the following terms:

- "municipal combined sewers"
- "storm building sewer"
- "storm building drain"
- "foundation drains"
- "normally open and normally closed back water valves"
- "combined and semi-combined drainage system"

27.2 Define the trade term, "back flooding".

27.3 Identify the conditions that may contribute to the possibility of back flooding.

27.4 State the section in Part 7 of the OBC that outlines the steps to control the effects of back flooding.

27.5 Explain the difference between a normally open and normally closed backwater valve.

Plumber- Level 3

- 27.6 Identify the type of backwater valve listed in Part 7 of the OBC.
- 27.7 Explain where a normally closed backwater valve may be installed in a drainage system.
- 27.8 State the type of devices that may be installed in a drainage system to control back flooding.
- 27.9 Identify the sections of the drainage system that may have devices installed to control back flooding and where a normally open backwater valve may be installed.

Plumber- Level 3

Number: S00032.28

Title: Open Flow and Metered Flow Roof Drain Systems

Duration: Total hours: 6

Theory: 6

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00024, S00025, S00027, S00029, S00030

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5463, U5465, U5466

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify and explain roof drain, roof drain connections, conventional flow roof and metered flow roof drain systems and size the different piping systems.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 28.1 Define the terms, "roof drain" and "rain water leader".
- 28.2 Explain why allowances for expansion and contraction must be allowed for when installing roof drains and rainwater leaders, and the consequences of non-allowance.
- 28.3 Explain how allowances are made in the storm drainage piping for expansion and contraction.
- 28.4 Describe the operation of a conventional flow roof drainage system.
- 28.5 Identify and apply all available rainfall tables.
- 28.9 State the recommended procedure for the location and spacing of roof drains.

- 28.10 Size a conventional and metered flow storm drainage system for a building.
- 28.11 Define the trade term, "metered flow roof drainage", and explain the purpose of installing this system, identifying the types of fittings installed in the roof drains.
- 28.12 Explain the purpose of fittings installed in the roof drains of a metered flow roof drain system.
- 28.13 Describe the operation of a metered flow roof drainage system.
- 28.14 State the recommended procedure for the location and spacing of roof drains.

SEWAGE DISPOSAL SYSTEMS:

Plumber- Level 3

Number: S00032.29

Title: Private Sewage Disposal Systems

Duration: Total hours: 4

Theory: 4

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00021, S00022, S00025, S00027, S00029

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5463, U5465, U5466

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, and explain the installation and operation of a private sewage disposal system.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 29.1 Describe the purpose of a private sewage disposal system.
- 29.2 Identify who is responsible for the administration and regulation of private sewage disposal systems.
- 29.3 List different types of private sewage systems.
- 29.4 Identify and list the information required for a private sewage disposal system installation.
- 29.5 Explain where septic tanks systems are installed.
- 29.6 State the operating principle of a septic tank system.

- 29.7 Specify the acceptable minimum distances between a septic tank and:
- a building
 - a property line
 - any source of water
- 29.8 Identify the type of bacteria that is necessary in a septic tank system.
- 29.9 State the materials used in the manufacture of septic tanks.
- 29.10 Identify the amount of ground cover required on top of a septic tank to prevent freezing.
- 29.11 Specify the minimum capacity of a septic tank for a given installation.
- 29.12 Describe the difference between the inlet and the outlet of a septic tank.
- 29.13 Explain the reasons for having two compartments in a septic tank.
- 29.14 Explain the reason for installing a siphon chamber and a pump chamber in a septic tank system.
- 29.15 Explain where storm water should be discharged when a septic tank is installed.
- 29.16 State if any plumbing fixtures are exempted from being connected to a septic tank.
- 29.17 Explain when a septic tank should be pumped.
- 29.18 State the purpose and location of a distribution box in a leaching bed system.
- 29.19 Define the term, "leaching bed".
- 29.20 Explain the purpose of a leaching bed.
- 29.21 Identify the types of leaching beds.
- 29.22 Explain the construction of a leaching bed.
- 29.23 Describe what takes place in the leaching bed when it receives effluent from a septic tank.
- 29.24 Identify the factors to be considered when locating a leaching bed.

29.25 Specify the location of a leaching bed in relation to:

- wells
- buildings
- property lines
- lakes
- rivers
- streams
- water courses
- ponds
- springs
- reservoirs

29.26 State the materials that may be used for leaching bed piping.

29.27 Specify the minimum height a leaching bed must be installed above a rock or a rock formation.

29.28 Specify the maximum allowable length of a lateral installed in a leaching bed system.

29.29 Specify the minimum and maximum grade of a lateral installed in a leaching bed system.

29.30 State how the piping is installed in a leaching bed system.

29.31 State the type of materials that should be installed as a cover over the leaching bed piping.

29.32 Explain the purpose of covering the leaching bed piping.

29.33 State the minimum allowable distance between each leaching bed trench.

29.34 Specify the minimum height of invert of a leaching bed above the highest maximum water table.

29.35 Explain the purpose, size, location, and acceptable materials for a header.

29.36 Describe how a header shall be installed when used on a leaching bed system.

29.37 Explain the purpose of a raised bed filter media installation.

29.38 Specify the types of materials used in the installation of a raised bed installation.

- 29.39 Identify how the bed dimensions are determined.
- 29.40 Identify the equipment required to lift the effluent into a raised bed.
- 29.41 Describe the test used to determine water absorption into the soil.
- 29.42 State the factors used in a percolation test.
- 29.43 Describe the standard procedures for a percolation test.
- 29.44 Identify the items necessary to calculate the required length of a leaching bed.
- 29.45 Calculate the required size of a leaching bed for two examples using the leaching bed sizing table.

Plumber- Level 3

Number: S00032.30

Title: **Municipal Sewage Disposal Systems**

Duration: Total hours: 4

Theory: 4

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00025, S00027, S00030

Co-requisites: S00032, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5463, U5465, U5466

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, and explain the operation of a municipal sewage disposal system.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

30.1 Define the following terms and abbreviations, including:

- "BOD"
- "sewage"
- "biodegradable"
- "PPM"
- "activated sludge"
- "bacteria"
- "flocculation"
- "mixed liquor"

30.2 Identify the purpose of mechanical screening.

30.3 Identify and explain the purpose and principle of operation of:

- grit removal
- primary settling
- aeration tanks
- secondary settling
- digesters
- vacuum filtration
- chlorination
- sedimentation ponds

- 30.4 Review the latest technology used in municipal sewage disposal systems.
- 30.5 Complete a flow chart indicating the steps involved in sewage treatment for a typical sewage treatment plant.
- 30.4 Review the latest technology used in municipal sewage disposal systems.
- 30.5 Complete a flow chart indicating the steps involved in sewage treatment for a typical sewage treatment plant.

PROCESS PIPING SYSTEMS:

Plumber- Level 3

Number: S00032.31

Title: Hydronic Heating Systems

Duration: Total hours: 14

Theory: 12

Individual/Group Work: 0

Out of Class Practical: 2

Prerequisites: S00021, S00022, S00024, S00025, S00027, S00029, S00030,

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5463,
U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, and explain the principle of operation of hydronic heating systems.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 31.1 Define the term, "hydronic heating", and describe its primary purpose.
- 31.2 Identify and explain the operation of hydronic heating components, including:
 - "packaged" boilers
 - combo water heaters
 - indirect water heaters
 - baseboards
 - radiant ceiling panels
 - radiators
 - unit heaters
 - staple up systems
 - sleeper systems
 - imbedded systems
 - snow and ice melt
 - circulation pumps
 - air separator
 - air eliminator
 - pressure tanks
 - automatic air vents
 - balancing valves

- control valves
- safety devices
- supply headers
- return headers
- supply lines
- return lines

- 31.3 Describe the procedure used to determine heating equipment requirements.
- 31.4 Perform a heat loss calculation, given a set of residential construction drawings.
- 31.5 Illustrate a basic hydronic installation by means of a single line drawing, including:
- heat source and components
 - primary loop and components
 - secondary loop and components
 - auxiliary loop and components
 - control wiring
- 31.6 Explain the principle of operation of a radiant floor-heating loop.
- 31.7 Identify the types of piping used for a radiant floor-heating loop.
- 31.8 Describe the installation procedures used for a radiant floor-heating loop.
- 31.9 Explain how the spacing of the piping in the loop will affect the amount of heat delivered to the loop.
- 31.10 Discuss the various temperatures of the water throughout heating systems.
- 31.11 Explain how the flow of water may be controlled through the zone.
- 31.9 Describe the steps involved in determining the pipe sizes required for a heating system.

Plumber- Level 3

Number: S00032.32

Title: **Hydronic System Calculations**

Duration: Total hours: 9

Theory: 9

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00022, S00024, S00025, S00027, S00029

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5458, U5459, U5461, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to calculate heat loss and pump sizes for hydronic systems.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 32.1 Define the term, "heat loss".
- 32.2 Define the term, "heat gain".
- 32.3 Calculate heat loss for the following:
 - slab on grade
 - walls below grade
 - walls above grade
 - windows
 - doors
 - ceilings
 - ice melt
- 32.4 Calculate the size of the pressure vessels.

32.5 Calculate the flow rate for:

- pumps
- pipe sizes (and include friction loss)
- expansion tanks
- operating pressures

32.6 Identify and calculate operating temperatures for:

- heat source differential
- supply and return differential
- set points

Plumber- Level 3

Number: S00032.33

Title: **Natural Gas Piping Systems**

Duration: Total hours: 3

Theory: 3

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00021, S00022, S00024, S00027, S00029

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U458, U5459, U5460, U5461, U5463,
U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, and explain the principle of operation of natural gas piping systems.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 33.1 Describe the chemical composition of propane and natural gas, and explain how natural gas is delivered.
- 33.2 State the pressures from the meter to the consumer's equipment, and describe the two purposes of a gas meter.
- 33.3 Define the abbreviations "CFH" and "BTU", and explain how to convert between them.
- 33.4 Identify the regulation that governs the installation of natural gas piping.
- 33.5 Identify and list the approved and prohibited piping materials for gas piping use.
- 33.6 Identify and list prohibited installation locations for gas piping.

- 33.7 Describe how natural gas piping is connected to gas-fired equipment.
- 33.8 State the gas installer's responsibilities in the installation of gas equipment.
- 33.9 Explain the different certification steps for gas-fitting licences.
- 33.10 Define and explain the following gas terms:
- "low pressure"
 - "intermediate pressure"
 - "pressure loss"
 - "manifold pressure"
 - "water column" (wc)
- 33.11 Convert inches of water column to ounces per square inch pressure.
- 33.12 Explain how a manometer is used to measure gas pressure.
- 33.13 Explain the procedure used to test for and locate a leak in a gas piping installation.
- 33.14 State the required test requirements for a variety of gas pipe installations.
- 33.15 Describe how to purge a gas pipe system.
- 33.16 Explain when, where, and how gas-piping is installed.

Plumber- Level 3

Number: S00032.34

Title: **Medical Gas Piping Systems**

Duration: Total hours: 3

Theory: 3

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00021, S00022, S00027

Co-requisites: S00032, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, and explain the basic installation requirements for a medical gas piping system.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 34.1 Define the term, "medical gas piping system".
- 34.2 Identify the type of buildings where medical gas piping is usually installed.
- 34.3 Identify the different types of medical gas piping systems.
- 34.4 Identify the test procedures used in medical gas piping systems:
 - purity
 - pressure
 - cross-connection
- 34.5 State the types of gases transported by medical gas piping systems.
- 34.6 Identify the standard used to regulate the installation of medical gas piping systems.

- 34.7 State the qualifications and certification required for the installation of medical gas piping systems.
- 34.8 Identify and list the type of piping materials, pipe fittings, and valves that may be installed in a medical gas piping system.
- 34.9 State the types of joining methods that may be used in a medical gas piping system.
- 34.10 State the support requirements for medical gas piping systems.
- 34.11 Describe the valve tagging and identification requirements for medical gas piping systems.
- 34.12 Explain any special procedures that must be taken when joining pipe and fittings together in medical gas piping systems.
- 34.13 Identify potential cross-connection hazards in medical gas piping systems.

Plumber- Level 3

Number: S00032.35

Title: **Industrial Process Piping Systems**

Duration: Total hours: 3

Theory: 3

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00021, S00022, S00027

Co-requisites: S00032, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5463,
U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, and explain the general installation requirements for a selection of industrial process piping systems.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 35.1 Define a "process piping system", and state its purpose.
- 35.2 Describe the difference between a process piping system and a plumbing system.
- 35.3 Identify industries where process-piping systems are installed.
- 35.4 Identify some common process piping systems, including:
 - compressed air
 - chemical supply piping
 - high purity water supply piping
 - food process piping
 - irrigation piping
 - brewery piping
 - oil refineries

Plumber- Level 3

- 35.5 Identify different acts, regulations, and specifications used to estimate, plan, install, inspect, and commission a variety of process piping systems.
- 35.6 Identify the authorities having jurisdiction for process piping systems, including:
- owners
 - owner representatives
 - engineers
 - health inspectors
 - municipal inspectors
 - pressure vessel inspectors
 - underwriters
- 35.7 Research, document, and report on a process piping system, including details such as:
- type
 - purpose
 - enforcing authority
 - any special training, certificates, or licenses required for installation
 - types of pipe, valves, fittings, and joining methods that may be used
 - support, testing, and commissioning requirements
 - specification, code, or act used

Plumber- Level 3

Number: S00033.0

Title: **PROCESS PIPING SYSTEMS**

Duration: 48 Total Hours

Theory: 0 Practical: 48

Prerequisites: S00021, S00022, S00023, S00024, S00025, S00027, S00028,
S00029, S00030

Co-requisites: S00032, S00033, S00034

Evaluation Structure

Theory Testing	10%
Application Exercises	80%
Final Assessment	10%

Plumber- Level 3

Number: S00033.1

Title: Perform Various Service, Maintenance, Repair, and Fabrication Assignments

Duration: Total hours: 48

Theory: 0

Individual/Group Work: 0

Out of Class Practical: 48

Prerequisites: S00021, S00022, S00023, S00024, S00025, S00027, S00028, S00029, S00030

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5463, U5464

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to perform various service, maintenance, repair, and fabrication assignments suited to particular geographical locations.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to perform a minimum of four of the following assignments:

- 1.1 Troubleshoot, shutdown, dismantle, rebuild, reassemble, and reactivate a variety of water closet and urinal flushometers.
- 1.2 Troubleshoot, shutdown, dismantle, rebuild, reassemble, reactivate, and set up a variety of electronic lavatory faucets, as well as water closet and urinal flushometers.
- 1.3 Perform a series of tests to determine if a domestic electric hot water is performing correctly.
- 1.4 Troubleshoot, shutdown, remove, disassemble, rebuild, reinstall, and set-up a simplex and/or duplex storm/sewage pump installation.

Plumber- Level 3

- 1.5 Balance a section of hot water circulation piping by identifying and adjusting balancing valves to a given flow.
- 1.6 Troubleshoot, shutdown, remove, disassemble, rebuild, reinstall, and set up a water pump installation.
- 1.7 Troubleshoot, shutdown, disconnect, remove, re-install, connect, and set up a domestic hot water circulation pump and water conditioning equipment.
- 1.8 Test a number of backflow prevention devices.
- 1.9 Layout and set a roof drain.
- 1.10 Pipe in a combination boiler/domestic hot water tank (combo unit).
- 1.11 Pipe in a domestic hot water boiler.
- 1.12 Pipe in a packaged domestic heating boiler.
- 1.13 Design and fabricate a pipe bending assembly.
- 1.14 Design and fabricate a tee-drilled header assembly.
- 1.15 Design and fabricate a plastic mitre-cut welded fitting.

Plumber- Level 3

Number: S00034.0

Title: Trade Documentation – Level 3

Duration: 48 Total Hours

Theory: 36 Practical: 12

Prerequisites: S00021, S00022, S00024, S00025, S00027, S00029, S00030

Co-requisites: S00032, S00033, S00034

Evaluation Structure

Theory Testing	80%
Application Exercises	10%
Final Assessment	10%

Plumber- Level 3

Number: S00034.1

Title: **Identify, Read, and Interpret Plumbing and Hydronic Piping Drawings**

Duration: Total hours: 9

Theory: 9

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00024, S00029

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5463, U5464

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to identify, read, and interpret plumbing and hydronic piping drawings.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 1.1 Define a "plumbing drawing" and a "hydronic piping drawing".
- 1.2 Explain the purpose of a plumbing drawing.
- 1.3 Explain the purpose of a hydronic piping drawing.
- 1.4 List the components that may be shown on a plumbing drawing.
- 1.5 List the components that may be shown on a hydronic piping drawing.
- 1.6 Define an "interference drawing".
- 1.7 Identify the drawings that must be read and interpreted to produce an interference drawing.
- 1.8 List the components that may be shown on an interference drawing.

Plumber- Level 3

- 1.9 Define a "spool drawing".
- 1.10 Identify the drawings that must be read and interpreted to produce a spool drawing.

Plumber- Level 3

Number: S00034.2

Title: **Read and Interpret Job Specifications for Industrial, Commercial, and Institutional (ICI) Sector**

Duration: Total hours: 9

Theory: 9

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00021, S00022, S00025, S00027, S00030

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5463, U5464

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to read and interpret a job specification for the ICI sector.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 2.1 Define a "specification".
- 2.2 Explain the purpose of a specification.
- 2.3 Identify the sections of a specification.
- 2.4 Explain the numbering system used in a construction specification.
- 2.5 Identify the number and section of the specification that relates to the plumbing system installation.
- 2.6 Identify the other sections of the specification that may relate to the section dealing with the plumbing system installation.
- 2.7 Identify the other sections of the specifications for which a plumber may be responsible.

Plumber- Level 3

- 2.8 Identify the key points included in the section of the specification relating to the installation of the plumbing system.
- 2.9 Interpret and apply information from job-site documents to ensure compliance and completion of tasks.

Plumber- Level 3

Number: S00034.3

Title: **Produce Various Plumbing Drawings**

Duration: Total hours: 12

Theory: 2

Individual/Group Work: 0

Out of Class Practical: 10

Prerequisites: S00022, S00025, S00027, S00030

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5463, U5464

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to create a number of plumbing drawings of various complexities.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 3.1 Produce a number of isometric drawings that illustrate:
- a section of a domestic water pipe system
 - a section of a residential DWV system
 - a section of a stack illustrating a multi-fixture wet vented group
 - a section of a horizontal branch illustrating a multi-fixture circuit vented group
 - a section of a domestic water pipe serving a multi-fixture washroom group
 - an elevator pit installation
 - an oil interceptor installation
 - a grease interceptor installation
 - an acid neutralizer installation
 - the DWV piping required for a commercial kitchen installation

Each drawing must:

- be drawn to scale
- include title block
- include a legend
- include a scale
- be fully sized
- be fully dimensioned

- 3.2 Produce an interference drawing.
- 3.4 Produce a spool drawing.
- 3.5 Produce a valve chart from a given drawing.
- 3.6 Identify how to tag pipe and valves, and label pipe, valves, and equipment.
- 3.7 Define and produce a shop-drawing manual.

Plumber- Level 3

Number: S00034.4

Title: **Produce Hydronic Drawings**

Duration: Total hours: 3

Theory: 1

Individual/Group Work: 0

Out of Class Practical: 2

Prerequisites: S00025, S00030

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5463, U5464

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to create a number of hydronic drawings of various complexities.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

4.1 Produce a number of isometric drawings that may illustrate:

- water make-up
- multiple boiler setup
- pumps
- valves
- expansion tank
- air separator
- primary loop
- secondary loop
- controllers
- heat emitters
- heat panels
- perimeter heat
- fan coil units
- indirect heaters
- indoor/outdoor sensors
- fresh air intake
- breeching

Each drawing must:

- be drawn to scale
- include a title block
- include a legend
- include a scale
- be fully sized
- be fully dimensioned

- 4.2 Produce a flow-schematic drawing.
- 4.3 Produce a spool drawing.
- 4.4 Define and produce a shop-drawing manual.

Plumber- Level 3

Number: S00034.5

Title: Bids and Contracts

Duration: Total hours: 9

Theory: 9

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00024, S00025, S00029, S00030

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5458, U5459, U5461, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to read and interpret bids and contracts.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 5.1 Define and explain the various bid processes.
- 5.2 Review bid documents to determine:
 - scope of work
 - responsibilities of contractor
 - scheduling
 - material types
 - terms of payment
 - liabilities
 - miscellaneous expenses
- 5.3 Define the following terms: "list price", "net price", "trade discount", and "chain discount" or "compound discount".
- 5.4 Calculate the net price of a trade-related item, given the list price and the discount.

- 5.5 Calculate the list price of a trade-related item, given the net price and the discount.
- 5.6 Calculate the discount of a trade-related item, given the net price and the list price.
- 5.7 Produce a material list to include the following components:
- type of materials
 - quantity of materials
 - list price
 - net price
 - material mark up, overhead, and profit
- 5.8 Define the term, "labour estimate".
- 5.9 Explain how a labour estimate may be made.
- 5.10 Identify the different labour estimators available.
- 5.11 Describe the use of a labour estimator.
- 5.12 Review and interpret contract types, including:
- lump sum price
 - stipulated price
 - cost plus/time and material
 - turn key

Plumber- Level 3

Number: S00034.6

Title: Simple and Compound Interest

Duration: Total hours: 6

Theory: 6

Individual/Group Work: 0

Out of Class Practical: 0

Prerequisites: S00024, S00029

Co-requisites: S00032, S00033, S00034

Cross Reference to Training Standards: U5458, U5459, U5461, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to solve trade-related problems involving simple and compound interest.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

- 6.1 Define the terms, "simple interest" and "compound interest".
- 6.2 Solve a number of trade-related problems involving both simple and compound interest.

Summary of Equipment Recommended for Level 3

Hand Tools:

adjustable wrench	pipe locator
ball-peen hammer	pipe wrench
basin wrench	plastic tube cutters (set)
broom	pliers (lineman, needle nose, water pump, channel locks)
calculator	plumb bob
caliper	pry bars
caulking gun	punch
chalk line	ratchet
chisels	ratchet cutter
claw hammer	rubber mallet
combination wrench	scale rule
compass	scratch awl
copper tube cutter	screwdrivers (complete set)
crimpers	shovel
drywall saw	sledgehammer
faucet seat wrench	snap cutter
flashlight	socket set (Imperial and SI)
hacksaw	soldering and brazing torch
hand saw	spud wrench
hand threader	T square
hex keys (set)	tap and die sets
hole saw	tin snips (set)
knife	torque wrench
levels	tri square
measuring tape and markers	tube flaring tools
micrometer	vice grips
pick	
pipe clamp	

Portable Power Tools:

chop saw	power drills
circular saw	reciprocating saw
concrete cutter	

Hoisting and Rigging Tools and Equipment:

block and tackles	shackles - varying sizes
chain block hoist (endless chain)	slings and chokers
come-alongs & Tirus TM	tuggers (power)
rope/cable	wire rope or nylon (synthetic)

Assorted Equipment:

air compressor & accessories
associated software
booster pump
builder's level
cellular phone
circular saw
computer
electrical tools
electronic leak detector
fax machine
hand pump & accessories
heat lamp

hydraulic cutter
hydrostatic pump & gauge
ladder
measuring instruments
oxy-acetylene welding equipment
pumps
steamer
telephone
testing documentation
tracing cable
two way radios
walkie-talkies

Protective Equipment:

face shield
fire blanket
fire extinguisher
first aid kit
gloves (industrial, rubber)
hard hat
hearing protection

lock-out
overalls
respiratory mask
safety boots
safety glasses/goggles
safety harness & life line

Cutting and Joining Equipment:

assembly tools and equipment
field lathes
file
hand-operated oiler
hot air gun (welder)
pipe cutter
pipe threader
pipe groover
pipe reamer
pipe roller

pipe stand
pipe vise
press-fit
Presto-lite™ gas tanks and soldering
equipment
tee drill
tube bender
tube cutter
turbo torch





